

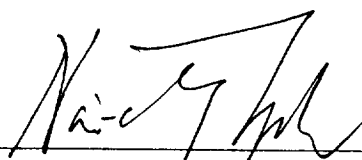
Final Report for NASA/Lewis Grant #NAG3-1899

**PRECISE MEASUREMENTS OF THE DENSITY AND CRITICAL
PHENOMENA NEAR PHASE TRANSITIONS IN LIQUID HELIUM**

Principal Investigator: Professor Nai-Chang Yeh

Project Period: 6/13/96 - 6/14/97

Budget Amount:



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I. INTRODUCTION

This report summarizes the accomplishments during the first year of the four-year project, entitled “*Precise Measurements of the Density and Critical Phenomena of Helium Near Phase Transitions*”. This project at Caltech is a part of a joint project between Caltech and NASA/JPL, the latter being led by Dr. Donald M. Strayer. The closing of the current grant to Caltech, NASA/Lewis Grant #NAG3-1899, is to facilitate centralized management of all the remaining funds by the Jet Propulsion Laboratory. The continuing research efforts to be conducted at Caltech for the project will be supported under work orders from Dr. Strayer at the Jet Propulsion Laboratory.

II. SUMMARY OF ACCOMPLISHMENTS

The first-year progress for the project of precise measurements of the density and critical phenomena of helium near phase transitions is summarized below:

- Completion of a cryogenic sample probe for the proposed measurements, and the rehabilitation of a designated laboratory at Caltech for this project;
- Construction and testing of a superconducting niobium cavity;
- Acquisition of one phase-locked-loop system for high-resolution frequency control and read-out;
- Setting up high-resolution thermometry (HRT) for temperature readout and control;
- Developing new approaches for calibrating the coefficient between the resonant frequency shift (Δf) and the helium density (ρ), as well as for measuring the effect of gravity on T_λ to a much better precision;
- Programming of the interface control of all instruments for automatic data acquisition;
- Improving data analyses and fitting procedures.

These accomplishments are essential for the continuing Caltech/JPL efforts in the completion of the NASA project led by Dr. D. M. Strayer at JPL.

III. CALTECH PERSONNEL INVOLVED IN THE PROJECT

- Nai-Chang Yeh, Professor of Physics, Principal Investigator.
- Nils Asplund, Staff Engineer. Involved in the design and construction of all low temperature apparatus.
- Jeffrey Huynh, undergraduate student. Involved in software development, and in the processing and testing of niobium microwave cavities.

IV. PUBLICATIONS

- [1] N.-C. Yeh, W. Jiang, D. M. Strayer, and N. Asplund, *Czech. J. Phys.* **46**, Suppl. **S1**, 181 (1996).
- [2] W. Jiang, D. M. Strayer, N.-C. Yeh, N. Asplund, and M. Lysek, *Proceedings of NASA Low-Temperature Microgravity Workshop*, Santa Barbara, (1997).
- [3] N.-C. Yeh, *Chinese Journal of Physics* **35**, 373 (1997).